



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/730,941

12/10/2003

Jae Suk Lee

021906-0306952

6290

909

7590

05/23/2008

PILLSBURY WINTHROP SHAW PITTMAN, LLP
P.O. BOX 10500
MCLEAN, VA 22102

EXAMINER

LANDAU, MATTHEW C

ART UNIT

PAPER NUMBER

2815

MAIL DATE

DELIVERY MODE

05/23/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/730,941	Applicant(s) LEE, JAE SUK	
	Examiner Matthew C. Landau	Art Unit 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 January 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3,5,6,13,15 and 16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3,5,6,13,15 and 16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

Claim 15 objected to because of the following informalities: the limitation “the first RU layer” should be changed to “the first Ru layer”. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim 15 is rejected under 35 U.S.C. 102(e) as being anticipated by Callegari et al. (US Pat. 6,664,186, hereinafter Callegari).

Regarding claim 15, Figure 28 of Callegari discloses a Cu layer 82 disposed on a substrate 30; a dielectric pattern 83 disposed between the substrate and the Cu layer; a first Ru layer 32 (col. 15, lines 9-13) disposed between the dielectric pattern and the Cu layer; an Ru_xO_y layer 33 (col. 15, lines 16-19) disposed between the first Ru layer and the Cu layer; and a second Ru layer 35 (col. 15, lines 39-42) disposed between the oxide film and the Cu layer.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-3, 5, 6, 13, 15, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Omstead (US Pat. 6,713,373) in view of Chyan et al. (US PGPub 2004/0051117, hereinafter Chyan).

Regarding claims 1 and 15, Figure 8 of Omstead discloses a barrier structure for copper metallization, comprising: a dielectric pattern 304 disposed directly on an upper surface of a substrate (not shown) (col. 3, lines 60-63); a first barrier layer (TaN) (not shown) disposed directly on an upper surface of the dielectric pattern (col. 6, lines 11-15); an Ru_xO_y film 404 (col. 3, line 54) disposed directly on an upper surface of the oxide film; a second barrier (Ru) layer 504 disposed directly on an upper surface of the oxide film; and a Cu layer 604/704 disposed directly on an upper surface of the second barrier (Ru) layer. The limitation "formed by a plasma treatment using N₂O or O₂" is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 227 USPQ 964, 966. Omstead does not specifically disclose the first barrier layer is a Ru layer. However, it is very well known in the art to use Ru as a copper diffusion barrier layer. For instance, Chyan discloses using Ru as a

Art Unit: 2815

diffusion barrier layer between a copper interconnect and a dielectric layer (paragraph [0023]).

In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Omstead by using Ru as the lower barrier layer instead of TaN for the purpose of selecting a material with greater conductivity. Furthermore, it would have been obvious to one of ordinary skill in the art to try a Ru barrier layer as taught by Chyan with the barrier structure taught by Omstead to achieve the predictable result of improved barrier properties with improved conductivity. *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385 (2007).

Regarding claim 2, Omstead does not specifically disclose the substrate is a silicon substrate. However, the Examiner takes Official Notice that it is very well known to use silicon substrates for the purpose of selecting an inexpensive semiconductor material (among other reasons).

Regarding claim 3, the limitation “the first Ru layer and the second Ru layer are formed by using a sputtering or CVD (chemical vapor deposition)” is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art. A further difference between Omstead and the claimed invention is the first and second layers have a thickness in a range from about 80 angstroms to about 120 angstroms. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Omstead by using the claimed range, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Art Unit: 2815

Regarding claim 5, the product-by-process limitation “obtained by oxidizing an upper part of the first Ru layer” does not structurally/patentably distinguish the claimed invention over the prior art. A further difference between Omstead and the claimed invention is the thickness of the oxide film is about 250 angstroms. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Omstead by using the claimed range, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claims 6 and 16, a further difference between Omstead and the claimed invention is the ratio of $x:y = 1:2$ (Ru_xO_y). Chyan discloses a conductive barrier layer formed of RuO_2 (paragraph [0023]). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Omstead by using the stoichiometry of RuO_2 (wherein $x:y = 1:2$) as taught by Chyan, since RuO_2 is the most readily formed and stable stoichiometry for ruthenium oxide.

Regarding claim 13, after the above combination, the first Ru layer, the oxide film, and the second Ru layer collectively form a conductive barrier structure for the Cu layer.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Callegari in view of Zurcher.

Regarding claim 6, the difference between Callegari and the claimed invention is the ratio of $x:y = 1:2$ (Ru_xO_y). Figure 7 of Zurcher discloses a capacitor electrode 70 made of RuO_2 (col.

Art Unit: 2815

3, lines 17-23). Note that the RuO_x film 33 shown in Figure 28 of Callegari is also a capacitor electrode. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Callegari to use the stoichiometry of RuO_2 (wherein $x:y = 1:2$) as taught by Zurcher, since RuO_2 is the most readily formed and stable stoichiometry for ruthenium oxide.

Allowable Subject Matter

The indicated allowability of claim 4 is withdrawn in view of the new rejection present above.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew C. Landau whose telephone number is 571-272-1731. The examiner can normally be reached on 9:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2815

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Matthew C. Landau/
Primary Examiner, Art Unit 2815